Optimization of the NCAR In Situ Turbulence Measurement Algorithm

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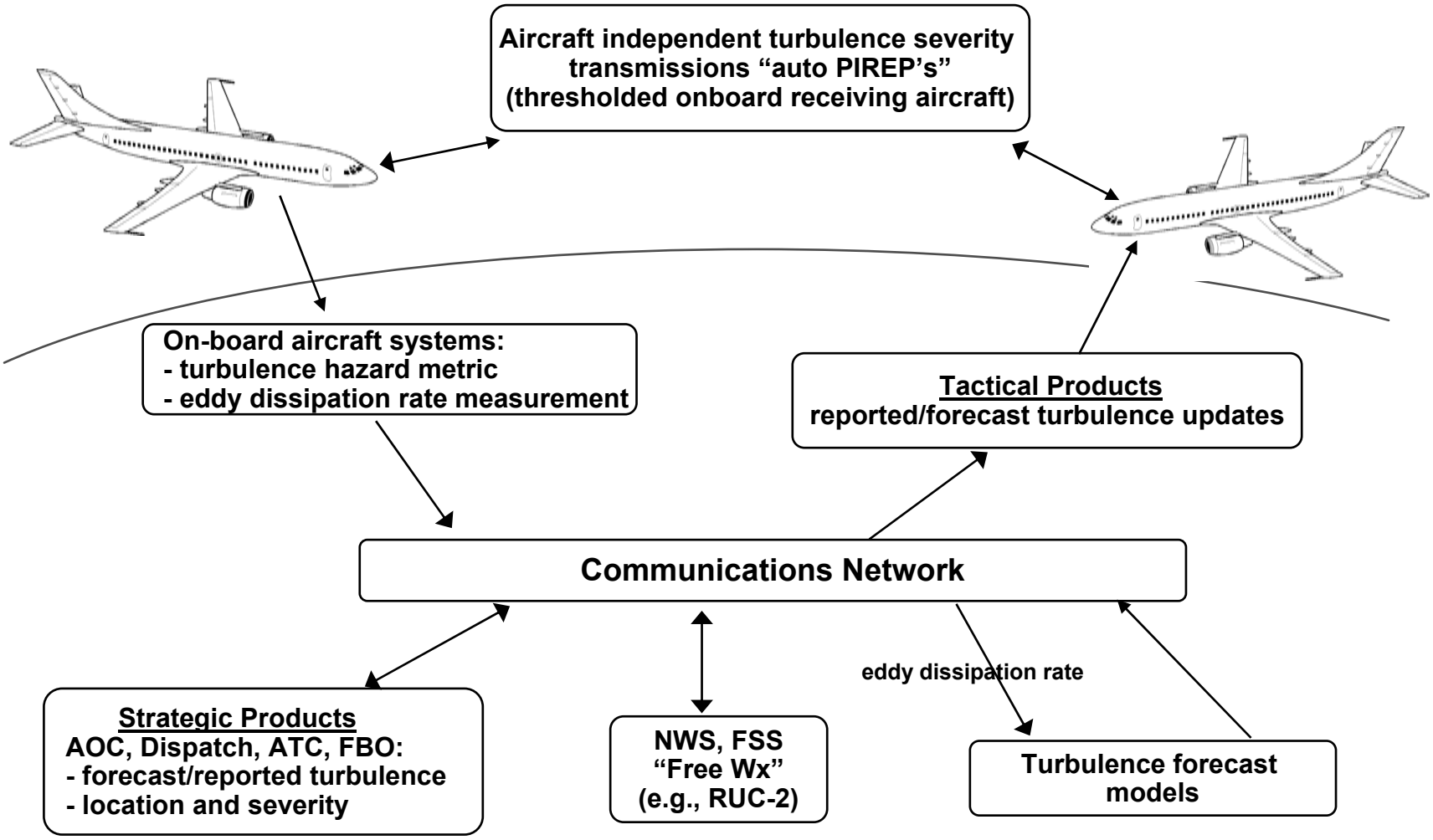
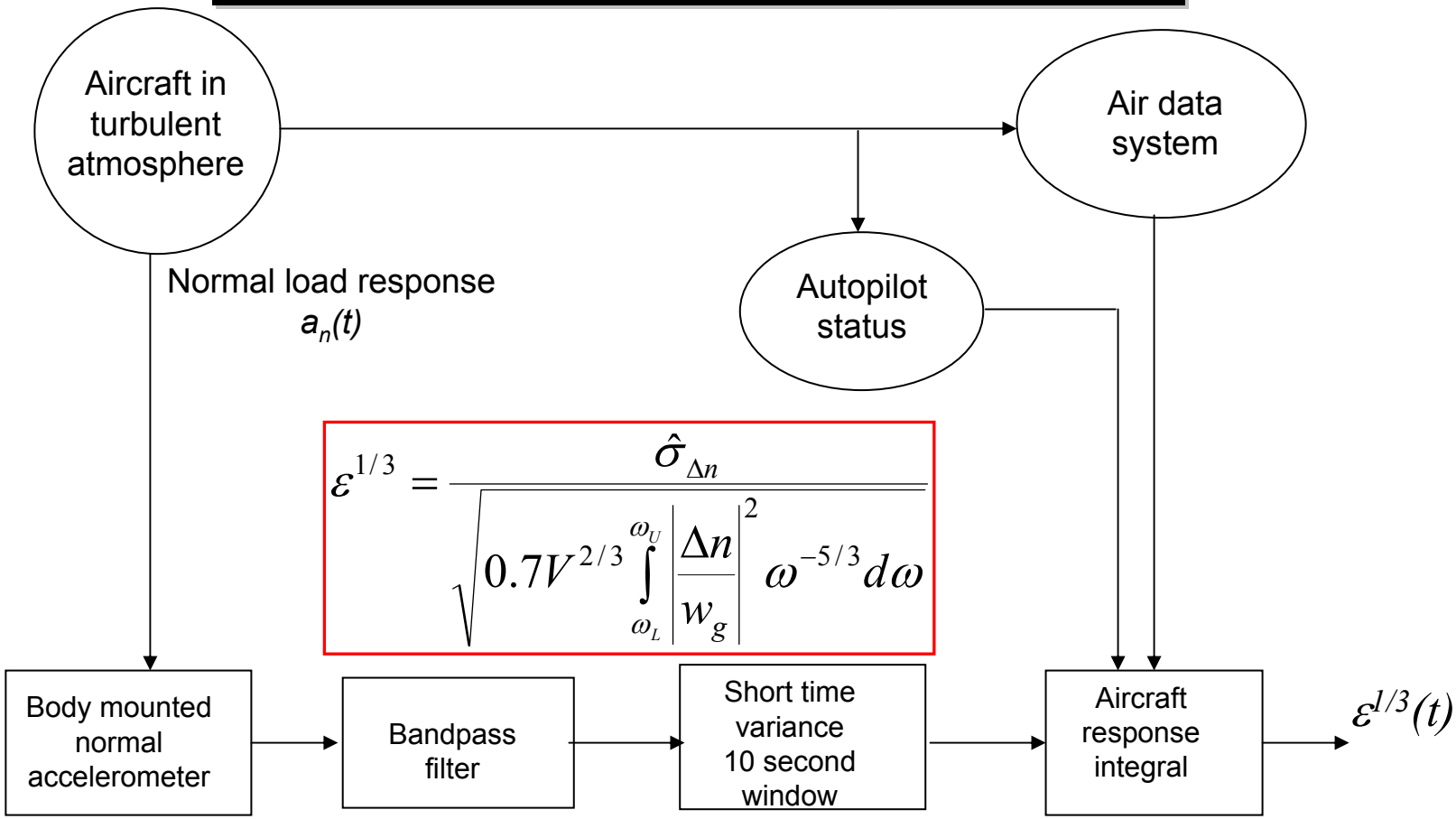
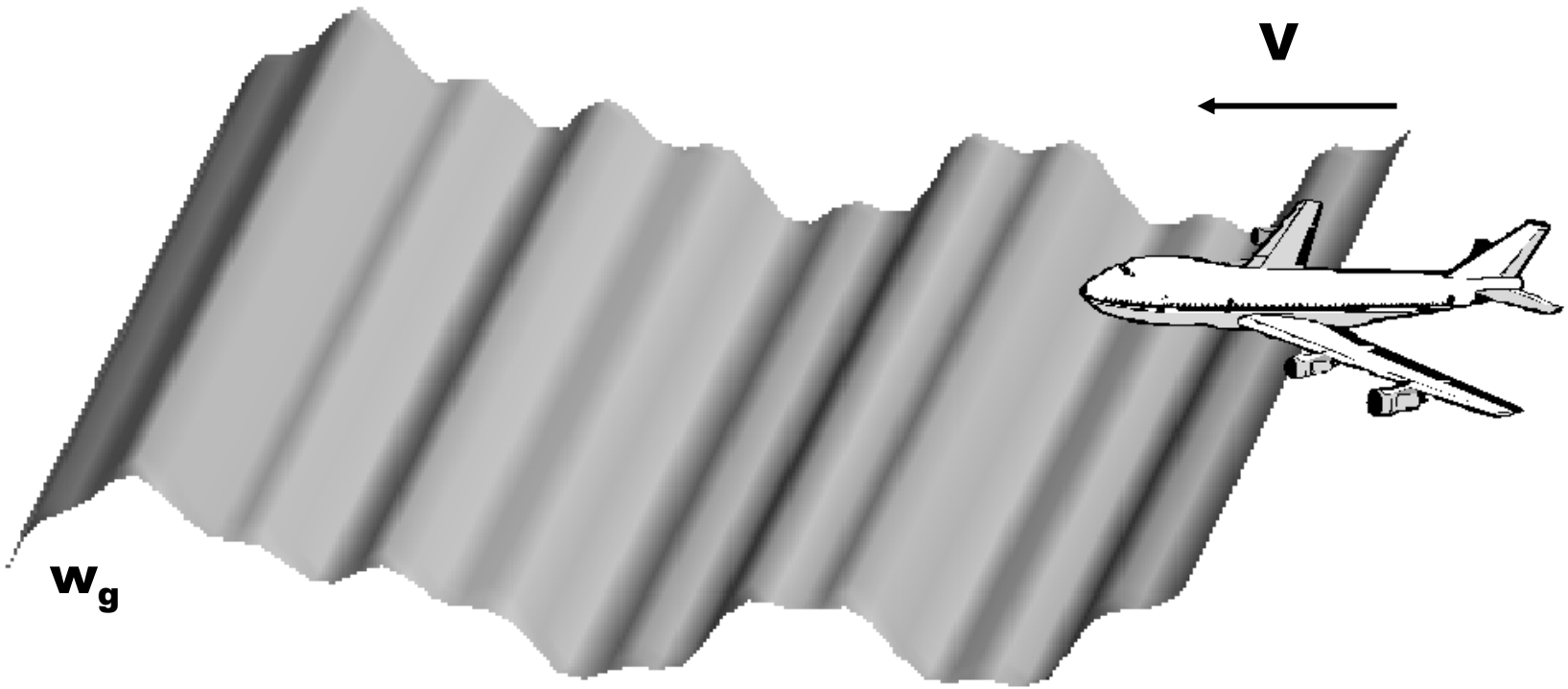
Turbulence Product Integration in Communications Infrastructure



NCAR In Situ Algorithm

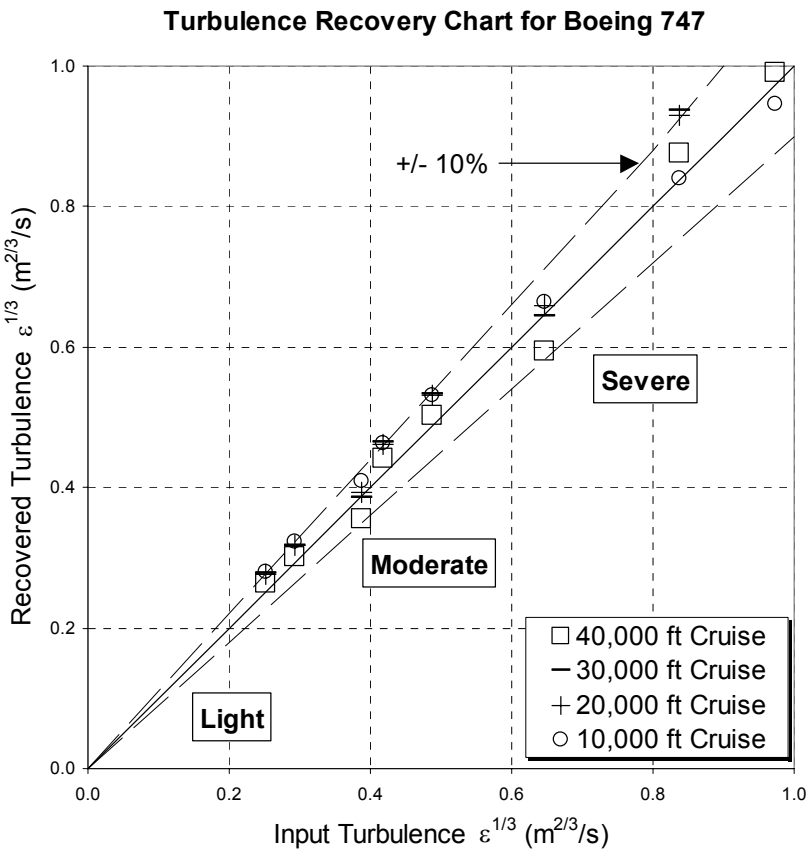


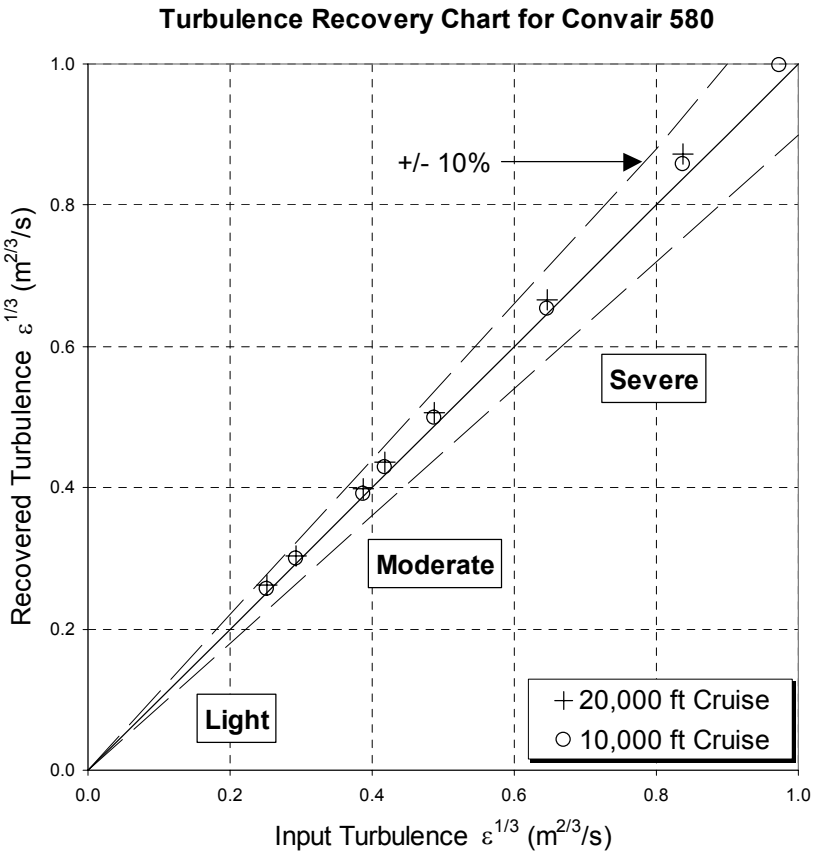
Turbulence Field Encounter



$$\omega = k\,V$$

Verification of the Method





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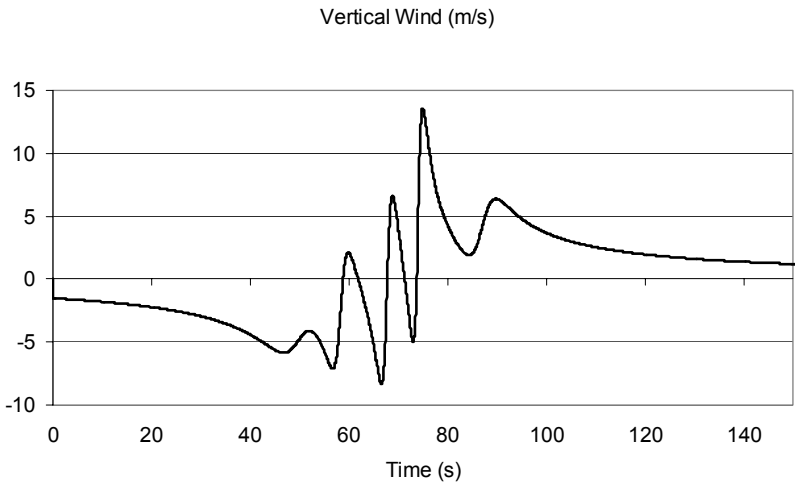
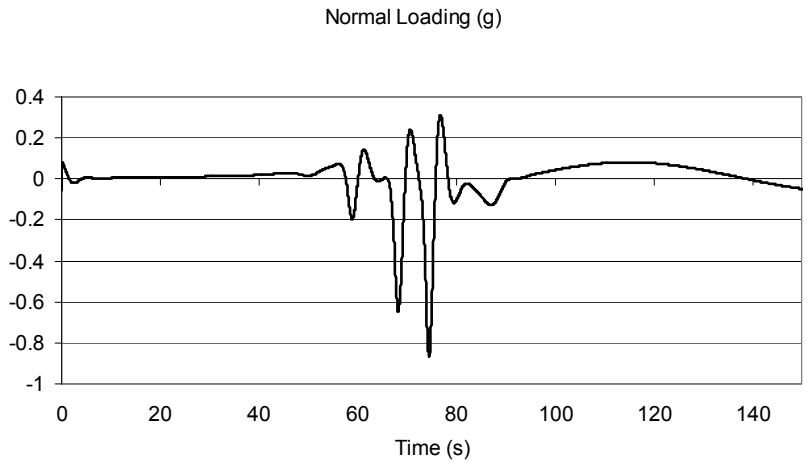
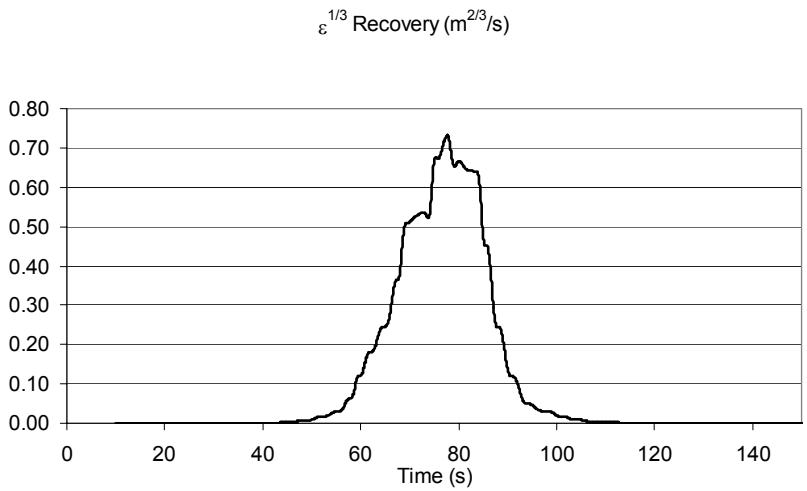
Issues Under Consideration

- Existence of inertial subrange
- Response to “discrete” events
- False and missed detection
  - control inputs
  - other gust inputs

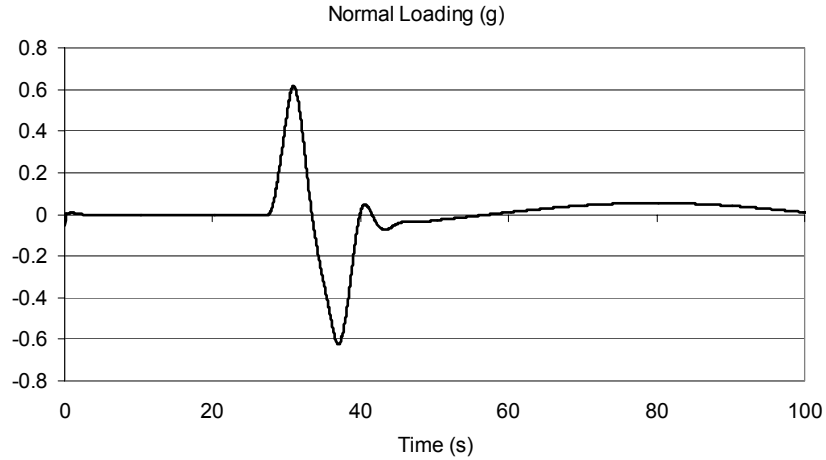
“Discrete” Event Encounter

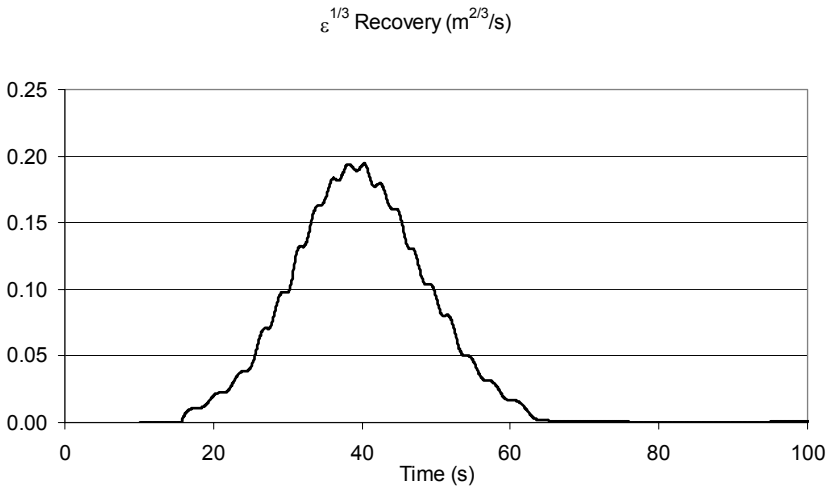






Response to Control Inputs





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In Situ Algorithm: Key Activities & Accomplishments

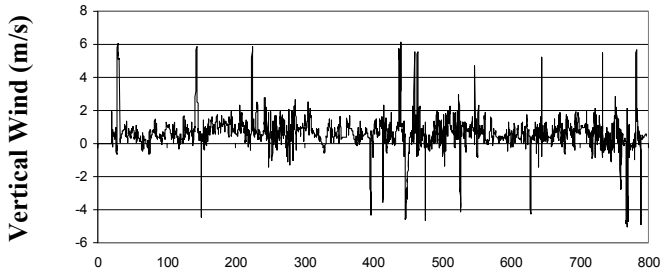
- **Algorithm implemented and tested for 3 different aircraft type simulations: B-747, Convair 580, and B-757**
  - Algorithm tested and evaluated successfully for very different aircraft types and flight regimes (in simulation).
  - Convair implementation supports Allied Signal development effort, and Greely field test analyses.
  - B-757 implementation begun 10/1/99. NASA providing aircraft data.

- **Supporting NCAR/FAA flight verification, fine tuning, and algorithm performance optimization preparatory to commercial fleet deployment**
  - supporting NCAR analysis of FOQA data in assessing aircraft models and algorithm accuracy.
  - From FOQA data, a library of test cases of turbulence encounters has been generated (see later slide). This allows the different aircraft to be flown through it, and the algorithm output evaluated for accuracy.
  - FOQA data also being used to evaluate accuracy of aircraft model in current B-737 implementation. More B-737 aircraft model data are required.

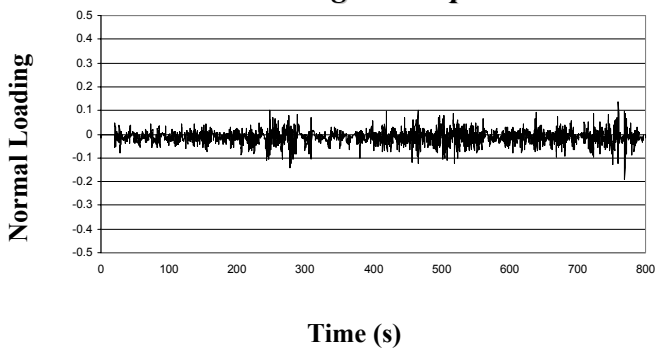
- **Algorithm will be implemented on NASA B-757 Research aircraft for integrated flight experiment August 2000**
  - Full and complete evaluation of the algorithm will be carried out in flight. The algorithm's accuracy and limitations will be evaluated and compared to other on-board "truth" measurements.
  - Possible future amendments will be evaluated.

An Example of the Application of FOQA Data

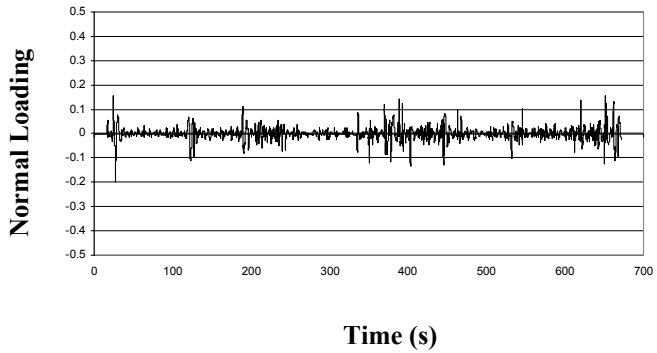
Derived Vertical Wind



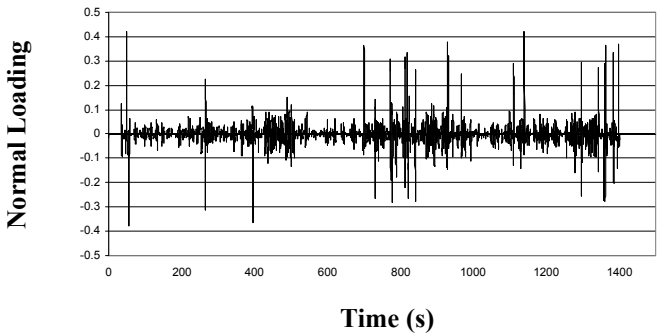
Boeing 737 response



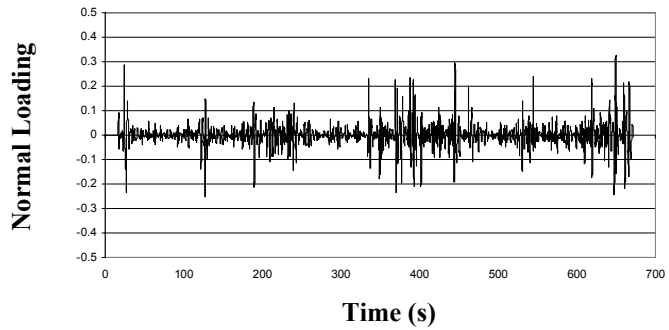
Boeing 747 response



Convair 580 response



Boeing 757 response



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Future Work

- Expand algorithm for other aircraft types as per FAA/NCAR program plan (through FY 00).
- Support fleet implementation and analysis of results (FY 00 and out as required).
- Incorporate algorithm on NASA 757 Simulator and Research Aircraft for integrated AWIN flight experiment (FY00 - 01).
- Perform detailed assessment of algorithm performance based on flight experiments. Review possible upgrades/implementation issues.
- Support NCAR use of flight data in producing turbulence nowcast/forecast products.